*Applying Usability Engineering to the Problems of Telepresence and Data Exploration*

*Oregon State University collaboration:*
**NACSE (Northwest Alliance for Computational Science & Engineering)**
**Dept. of Civil, Construction, and Environmental Engineering**
**Hinsdale Wave Research Lab**

**NACSE   Oregon State University**

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## *Re-Engineering the Wave Research Lab*

**Extend the capacity of the physical facility**
Largest tsunami research facility in the world
Support 3-D bathymetry (real-world seabed and shoreline shapes)

**Enhance effectiveness of WRL researchers through usability engineering**

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# Applying Usability Engineering

## Human factors

Characteristics, capabilities and limitations of human beings

How these affect our use of technology

## Usability engineering

Addresses human factors explicitly during design process

To improve system effectiveness and safety

To improve user productivity

# Why Is Usability Engineering Important?

**A system that doesn't**

Respond to user needs

Align with user processes

Accommodate user expertise

**may be worse than no system at all!**

## *Usability Engineering and NEES*

**UE can make it possible for researchers to**
- **Control and observe experiments from remote sites**
  - Reduce requirement for <u>on-site presence</u>
- **Gain more from experimental processes**
  - Exploit technology to enhance human <u>observation</u>
- **Share experiments with colleagues and students**
  - Broaden <u>participation</u> in experiments
  - Extend <u>useful lifetime</u> of experimental processes
- **Exploit corpus of experimental results**
  - Facilitate <u>re-use</u> of previous experimentation
  - Support <u>integration</u> of computational and experimental modeling

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## *Telepresence:  The Raw Ingredients*

**Sensor data:  raw, filtered, graphical summaries**
- 10s to 100s of devices operating concurrently

**Data streams from remotely operable cameras and microphones**
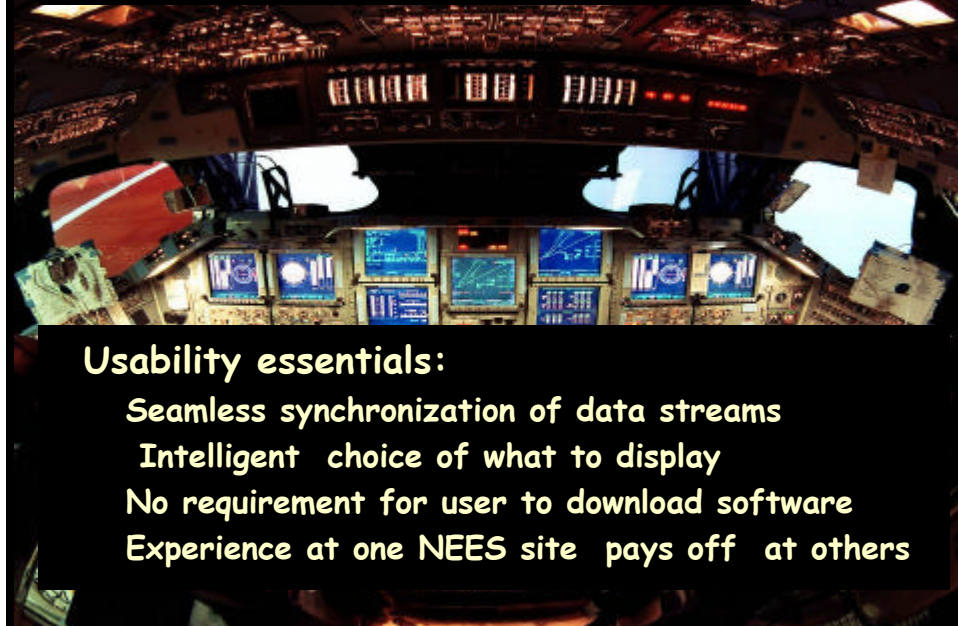- 10s of devices at eye level, suspended from roof, and underwater

**Robotic controls**

**Use of computation to merge/analyze real-time data streams**

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## Without attention to usability . . .



**Usability essentials:**
Seamless synchronization of data streams
Intelligent  choice of what to display
No requirement for user to download software
Experience at one NEES site  pays off  at others

## Engineering the User Experience

*Role 1:*  **Steering and observing the <u>remote experiment</u>**
Researcher(s) sets up and directs experiment in near-real-time
Colleagues from same/other institutions participate
Observe/assimilate/discuss varying sets of data streams

*Role 2:*  **After-the-fact <u>experiment replay</u>**
Researcher(s) observe experiment in simulated time
Identify subsets of data streams for targeted uses

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# Issues in Remote Steering/Observation

**Goal:** Make remote experimentation efficient and useful

Helping PIs select optimal control settings

Acquiring metadata only the PI can furnish

Placing audio/video effectively

Integrating sensor data into meaningful summaries

Intelligent management of displays

Instant Replay to improve on traditional viewing

Electronic Lab Notebook: saving/annotating records for personal use

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# Issues in Experiment Replay

**Goal:** Make it possible to derive real benefit from others' experiments

Generating markers for interesting events in sensor and audio/video streams

Zooming forward through simulated time to next event, then slow-stepping through critical data sequences

Synchronized access to raw/filtered/summarized data

Ability to download arbitrary sequences of data

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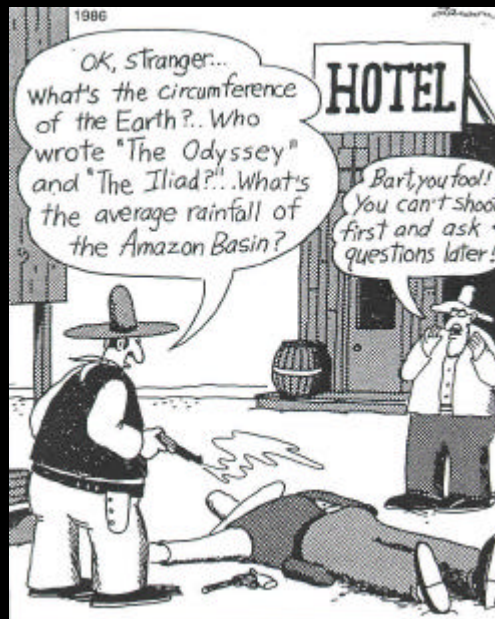
Usability engineering means working <u>with</u> users to identify their needs and preferences

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# *Data Exploration:   The Raw Ingredients*

Extremely large quantities of data must be archived and made publicly available

Synchronization markers must be added

Diverse data formats need to be integrated

Metadata need to be standardized

Must be possible to compare experimental data with data from simulations

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## Engineering the User Experience

**Tsunami Experiment Databank** archives all aspects of NEES experiments

*Role 3:* **Single or collaborative researchers use search-and-exploration interfaces**

- So duplication can be eliminated
- So models can be calibrated
- So model results can be validated

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## Issues in Databank Exploration

**Goal:** Make searching flexible enough to quickly locate appropriate experiments

Generating most metadata automatically during data acquisition/processing

Multi-tiered interfaces that support typical user scenarios:

- Experiments involving certain wave configurations
- Experiments involving certain types of models
- Experiments yielding particular types of results
- Find experiments similar to this one

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